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# Preparedness and Emergency Response Research Centers: Early Returns on Investment in Evidence-Based Public Health Systems Research

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In today's environment of an increased need to demonstrate the value of the federal investment in public health preparedness and response (PHPR), it is encouraging to see the results of the research conducted by the Preparedness and Emergency Response Research Centers (PERRCs), which were funded by the U.S. Centers for Disease Control and Prevention (CDC).<sup>1</sup> The research generated by the PERRCs represented in this special supplement of *Public Health Reports*, "Outcomes from the Federal Investment in Public Health Systems Research to Strengthen Preparedness and Response," is not only impressive but also vital in adding to the evidence base for our PHPR efforts. The PERRCs have demonstrated the value of public health research that collectively advances our thinking and understanding of how to improve our public health system's preparedness for and response to disasters.

Investigators share a wealth of practical insights to help bolster the continuing development and refinement of the public health system contribution to emergency preparedness and response. The research reported in this supplement reflects a confluence of three disciplinary trends in the field: (1) the application of methods, frameworks, and analytical strategies from the evolving field of public health systems and services research (PHSSR) to the specialized practice domain of PHPR; (2) a move, generally, toward more rigorous study design within the field of public health emergency preparedness and response research; and (3) the influence of themes and analytical strategies from more established fields, such as social science-oriented disaster research, psychometrics, and operations research.

## APPLICATION OF METHODS, FRAMEWORKS, AND STRATEGIES FROM PHSSR TO PHPR

The application of methods, frameworks, and analytical strategies from PHSSR to PHPR arises directly from a mandate in the 2006 Pandemic and All Hazards Preparedness Act (PAHPA) to develop a "knowledge base" to address the gap between "tremendous financial investment to date for public health preparedness and no evidence-based measures for evaluating progress or preparedness."<sup>2</sup> Based on this policy mandate, CDC directed the Institute of Medicine (IOM) to identify gaps in knowledge about public health systems preparedness and emergency response and to articulate recommendations for near-term priority areas for research.

The IOM outlined four priorities in a letter report: (1) enhancing the usefulness of training, (2) improving emergency and risk communications, (3)

creating and maintaining sustainable systems of PHPR, and (4) generating criteria and metrics for measuring public health effectiveness and efficiency.<sup>2</sup> From 2008 to 2014, CDC granted \$57 million to sponsor research programs at nine PERRCs, selected on a competitive basis, at accredited U.S. schools of public health. The PERRCs are the first and only U.S. Department of Health and Human Services (HHS) program to use a public health systems research approach to investigate and improve the complex and rapidly changing PHPR systems. The IOM report illustrated the complex orientation of interdependent entities that form the public health systems.<sup>3</sup>

The CDC funding mandated that PERRCs emphasize multidisciplinary research, in collaboration with the state and local public health practice community, to improve public health practice and advance preparedness and response science. The articles in this issue represent the range and reach of the numerous original research initiatives undertaken by PERRC researchers and their public health system partners to help strengthen the nation's emergency preparedness and response capacity and to promote disaster resilience in the years to come. They also indicate the future challenges and opportunities facing practitioners, researchers, and policy makers working within the public health emergency preparedness and response enterprise. This supplement highlights some of the evolving trends in this emergent research and practice field.

## ADVANCING STUDY DESIGN

Three earlier reviews of the public health emergency preparedness and response research literature analyzed the span and scope of the evolving field based on findings published from 1997 through 2008.<sup>4-6</sup> All three reviews noted the increase in the number of articles published in the field but criticized the general lack of empirical rigor and the dearth of research designs that could lead to generalizable findings. Savoia et al. noted that “the promise of PHSSR to improve the preparedness of public health systems has yet to be fulfilled.”<sup>5</sup> In the years since those literature reviews were published, a number of disasters and complex emergencies have occurred and drawn the attention of public health and disaster health researchers: pandemic influenza A(H1N1) (2009); the Deepwater Horizon oil spill (2010); the Haiti earthquake and subsequent cholera outbreak (2010); the Japanese tsunami and subsequent Fukushima Daiichi nuclear disaster (2011); the Joplin, Missouri, EF-5 tornado (2011); and major hurricanes such as Irene (2011), Isaac (2012), and Sandy (2012). The research community, sensitive

to the variability, unpredictability, and rarity of major disaster events and the need to capitalize on available data, has sought to examine these events' population health consequences and consider public health systems' mediating aspects.

Five of the PERRC studies described in this issue use data from one or more of the aforementioned events to model or analyze public health system organization or effectiveness.<sup>7-11</sup> As with all of the PERRC research illustrated in this issue, these articles address one or more of the four research priorities noted in the IOM letter report to CDC.<sup>3</sup> PERRC research also addresses cross-cutting issues for preparedness and response, such as identifying and addressing the unique needs of at-risk populations and rural communities. In contrast with much of the earlier published research, the PERRC studies move beyond case reports or descriptive studies and focus on understanding something more fundamental. Several articles explore the design of the systems at work in responding to each disaster event. For example, Moriarty et al. examine immunization information systems and their utility during pandemic events.<sup>9</sup> Other articles illuminate the social determinants of key system outcomes, such as the factors associated with more effective or comprehensive communication strategies<sup>8</sup> or the institutional factors affecting preparedness planning for at-risk populations.<sup>11</sup> The authors, in addition to exploring systems' design and determining ways in which the systems could be improved or enhanced for future responses, focused on developing models, tools, and other applications to aid in knowledge transfer for real-world outcomes.

## MULTIDISCIPLINARY APPROACH

Learning from other disciplines and adapting tools from outside the public health domain is an important conceptual underpinning of this research as well. Often, public health practice-based research approaches the research question using the public health paradigm. The reality is that there is much to be learned by adapting organizational models and theories taken from health services research, operations research, or other research fields to the public health context. The work reported by Enanoria and colleagues<sup>12</sup>—applying the time-tested principles related to mutual aid in the context of epidemiology and surveillance—as well as the work by Yaylali et al.<sup>10</sup> in applying systems engineering methods to public health preparedness are examples of adapting outside models to the public health context. This supplement also showcases novel strategies for examining public health emergency response systems, such as Rutkow and colleagues<sup>13</sup> and Guclu et al.'s<sup>14</sup>

use of legal research analyses to examine regulatory and policy frameworks, Piltch-Loeb et al.'s<sup>15</sup> use of root cause analysis, Guclu et al.'s<sup>14</sup> use of social network analysis, and Schuh et al.'s<sup>16</sup> use of mixed methods to analyze public health response data.

One common theme among PERRC research is interdependence. As a number of the articles in this supplement suggest, public health is more likely to succeed in detecting an adverse health event or minimizing a disaster's health impact when it can effectively leverage community resources or join with other system partners to deliver results. The articles in this supplement also share three important characteristics: (1) a public health system orientation, (2) a reference to adapting and learning from other disciplines, and (3) continuous improvement designed within the intervention.

## PUBLIC HEALTH SYSTEM ORIENTATION

The public health system orientation of these research efforts provides an important perspective on the context in which public health preparedness for potential threats and hazards is conducted. The public health system comprises the organizations and individuals within the community who have a stake in the community's health and vitality.<sup>17</sup> In this context, the "community" could be defined as a political subdivision at a federal, state, local, or neighborhood level. The public health system also transcends government levels and acknowledges that the local community, depending on the circumstances, may need services from the federal government (e.g., Federal Emergency Management Agency and HHS), the state government (e.g., state health department and state emergency management), and the local government (e.g., county health department and municipal fire department), as well as resource sharing among public and private sectors (e.g., governmental public health workers, church-based food pantries, community-based service organizations, and nongovernment service organizations). This public health system orientation is important to recognize and acknowledge; it introduces a significant influence on enhancing impact beyond the individual organizational entity in the community and recognizes the potential for synergistic impact.

This PERRC program has not only expanded the existing knowledge base for emergency preparedness and response, but has also potentially strengthened the public health system as a whole, as many of the findings reported in this supplement and elsewhere<sup>18</sup> go beyond specific emergency preparedness and response applications. The organizational learning through

peer assessment using the root cause analysis process described by Piltch-Loeb et al.<sup>15</sup> holds particular promise in facilitating a culture of systems improvement. The public health preparedness knowledge presented by PERRCs is also directed toward improving and supporting everyday public health practice, partly by building community resilience, as we learn in the studies of Enanoria et al.,<sup>12</sup> Shoaf et al.,<sup>19</sup> McCabe et al.,<sup>20</sup> and Karasz et al.<sup>21</sup>

## CONTINUOUS IMPROVEMENT DESIGNED WITHIN THE INTERVENTION

Finally, inherent in each article are the design elements of continuous improvement. While public health, as a discipline, has long valued program evaluation, today's most effective public health programs must be able to translate such systems research into tangible practice improvements. In much the same way that the biomedical field has advanced its research with a "bench to bedside" model that explicitly links basic science with clinical practice, PHPR systems research has to move from "digital data to disasters" and develop clear feedback loops between research and practice. The research articles describing root cause analysis<sup>15</sup> and applying the adaptive response metrics<sup>16</sup> are examples of research that relies on principles underlying a continuous improvement perspective. To the extent that these and other novel strategies from this research portfolio inform emergency practice, it will go a long way toward addressing the "knowledge gap" first noted in the 2006 PAHPA legislation.<sup>2</sup>

What may be less evident when reading these PERRC articles alone, but is clear to readers of disaster research literature, is that these research studies represent unique contributions to the evidence base for PHPR practice. By applying rigorous analytical strategies to the questions of system design and performance and the relationship of public health systems and practice to human health outcomes, PERRC research has enhanced the PHPR field's knowledge of what works and why. PHSSR approaches to organizational design and effectiveness reflect novel approaches to the disaster research field, as does the emphasis on population health as a key disaster outcome. These articles illustrate our research field's evolution, but they also reflect that the field is at a critical juncture. Generating such research requires a commitment to applying the lessons learned to measure and design high-performing public health systems. One future research endeavor could be to conduct a cost-benefit savings analysis in public health response costs, or in mortality or morbidity averted, similar to the work of Rose et al.<sup>22</sup>

Taken together, the research described in this supplement has the potential to transform the public health preparedness field in significant ways and to inform PHPR decision making while highlighting the collaborative efforts of academic researchers, public health officials and their partners, and CDC. The PERRC research presented in this supplement and elsewhere<sup>18</sup> has demonstrated that using PHSSR methods can identify effective interventions and practices that improve PHPR systems and services. The research reported by the PERRCs is just the beginning of the return on the federal investment to date in the field of emergency preparedness and response. There needs to be an increased focus on accelerating the successful translation of PERRC research to public health practice and policy, and on taking existing practices through rigorous evaluation and research for sustainable improvements. As in all areas of public health, continued research and evaluation is central to improving the practice of public health, and in no area is it more important than in promoting public health preparedness.

The contents, findings, and views contained in this article are those of the authors and do not necessarily represent the official programs and policies of the Centers for Disease Control and Prevention (CDC), the Agency for Toxic Substances and Disease Registry, or the Department of Health and Human Services.

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